Agronomic character of several local genotypes of sorghum (*Sorghum bicolor* l.) at East Java

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Agronomic character of several local genotypes of sorghum (*Sorghum bicolor* l.) at East Java

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Abstract. Sorghum classified as an annual crop that is very easy to be cultivated but its production until now classified as lagging compared to rice, corn and other cereals. In an effort to increase the fulfillment of food needs, sorghum plants can be developed in Indonesia as an alternative to local food other than rice. The development of sorghum plants is considered capable of supporting government programs to prevent the policy of importing rice and wheat.
This study aims to determine the character of several genotypes of local sorghum East Java grown on paddy fields in Purutrejo Village, Purworejo Sub-District, Pasuruan City at an altitude of 5 m ASL with alluvial soil type. The average temperature is 29^{o}C - 34^{o}C with an average rainfall of 1430 mm / year. The study was conducted from June to August 2017. The experiments were arranged in a Randomized Block Design, using nine local sorghum genotypes replicated three times. Nine genotypes of local sorghum are Pasuruan, Lamongan 1, Lamongan 2, Tuban, Sampang 1, Sampang 2, Tulungagung 1, Tulungagung 2 and Jombang.
The results showed that nine characterized genotypes had various agronomic characteristics on plant height, leaf number, stem diameter, panicle length, number of seeds per panicle, seed weight per panicle and 100 seed weight.

Keywords: Characterization, Local Genotypes, Sorghum

1. Introduction

Efforts to increase food production in Indonesia to meet the increasing population needs are more difficult. Limitations of suitable land to produce food and unpredictable global climate change are among the obstacles to be faced. Marginal land becomes an alternative in an effort to increase food production with various limitations of soil physical and chemical properties. Under these conditions, sorghum can still grow and produce, so that it can be developed as an alternative to local food other than rice [1]. In areas that often experience drought or get inundated with floods, sorghum plants can still be cultivated. Therefore, there is considerable opportunity to increase sorghum production and obtain superior varieties of sorghum [2]. Sorghum is a multipurpose plant, both as food, feed, and industrial materials processing. As a food, sorghum nutrition is not much different from other cereals [3]. In general, the level of sorghum protein is higher than maize, brown rice and barley but lower than wheat. Sorghum fat content is higher than brown rice, wheat, millet but lower than corn [4].

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One of the problems faced in the development of sorghum commodities in Indonesia is the lack of development of superior varieties, especially the result of the development of local genotypes. In East Java, for example, there are still unidentified and characterized wild genotypes of sorghum [5]. The identification of wild genotypes and accessions is necessary in order to develop local sorghum cultivars. Identification and characterization are the first steps used to discover the genetic variation of plants in the development of a superior cultivar type through breeding. Without diversity, improvements in the properties of a plant are impossible [6].

Food Security Agency includes sorghum as one of the commodities supporting the diversification of national food. The results of the Cereals Plant Research Institute showed that sorghum can substitute rice up to 30% with a taste that is acceptable to consumers [7]. In food self-sufficiency program, the Agency for Agricultural Research and Development has made efforts to procure new varieties of sorghum, but because the priority of development is still on rice and corn commodities, starting from 1960 until 2001 only 15 varieties were released, then 2013-2016 increased 6 varieties.

Based on the development of superior varieties of sorghum data in Indonesia and the fact that the government still needs the effort to support the success of food security, it is necessary to conduct research on the characterization of several local sorghum genotypes found in East Java.

2. Materials and methods

This research was conducted in Purutrejo Village, Purworejo Sub-District, Pasuruan City at an altitude of 5 m ASL with alluvial soil type. The average temperature is 29^{o}C - 34^{o}C with an average rainfall of 1430 mm / year. Research has been carried out in June - August 2017. The tools used in the research include cultivation tools and measuring tools. The materials used are local genus of sorghum genotypes obtained from six districts in East Java, manure and NPK fertilizer (Urea, SP-36, and KCl).

The study was arranged in Randomized Block Design with three replications and used nine local genotypes of sorghum, namely Pasuruan, Lamongan 1, Lamongan 2, Tuban, Sampang 1, Sampang 2, Tulungagung 1, Tulungagung 2 and Jombang. Each unit (plot) of the experiment contained 15 plants with 3 sample plants, selected plants that are in the middle row.Characters observed included plant height, number of leaves, stem diameter, panicle length, number of seeds per panicle, seed weight per panicle and 100 seed weight.

All genotypes were planted simultaneously in Pasuruan district with consideration: a. All genotypes will get a uniform treatment, b. Facilitate in the observation and retrieval of data. The planting was done by cultivation with a spacing of 70 cm X 30 cm in the prepared plots. Treatments include watering, weeding, hatching, pest and disease control and fertilization.

3. Results and discussion

Based on the analysis of the variety of genotypes for the seven characters observed, i.e. plant height, number of leaves, stem diameter, panicle length, number of seeds panicle^{-1}, seed weight panicle^{-1} and 100 seed weight showed significantly different results in 5% level. Differences in plant growth are influenced by internal factors such as genes and hormones that affect growth through inherited traits. External factors such as nutrients, water, temperature, humidity, and light also give different effects on the characteristics of a plant [8].

3.1 Plant Height, Leaf Number, and Stem Diameter

Further Tukey Test assay results, several genotypes showed differences in plant height, leaf number and stem diameter. Table 1 shows that genotype Tulungagung 1 is higher than the others with a mean of 389.38 cm. The lowest plants were Lamongan 1 genotype (168,10 cm) and were not different from Sampang 1 and Sampang 2.

Similarly, the number of leaves and stem diameter, the highest mean was owned by Tulungagung 1 genotype (strands respectively 13.56 and 2.44 cm), although there are several genotypes that match. The lowest number of leaves is Tulungagung 2 genotype, which is 5.78 pieces, while the lowest diameter is found in Sampang 2 genotype (1.32 cm).

From the data mentioned above can be explained that the high plant does not necessarily have many leaves because the stem of sorghum consists of segments that are leaf seating. Plant height is affected by the length of the segment while the number of leaves depends on the number of segments [9].

The growth of stem diameter in addition to the genetic properties of each genotype is also influenced by environmental factors and the photosynthesis process in the leaves.

Table 1. Plant height, number of leaf and diameter of stem

Genotype	Plant Height (cm)	Number of Leave	Stem Diameter (cm)
Pasuruan	225.48 b	8.78 abc	1.53 a
Lamongan 1	168.10 a	12.78 cd	2.32 bcd
Lamongan 2	218.70 b	11.11 bcd	2.42 cd
Tuban	319.28 c	10.56 bcd	1.87 abc
Sampang 1	200.69 ab	7.00 ab	1.32 a
Sampang 2	195.21 ab	8.78 abc	1.51 a
Tulungagung 1	389.38 d	13.56 d	2.44 d
Tulungagung 2	232.17 b	5.78 a	1.48 a
Jombang	304.78 c	10.78 bcd	1.80 ab
Tukey Test 5%	45.64	4.47	0.57

Note : The numbers followed by the same letter in the same column show no significant difference in the 5% Tukey Test

3.2 Length of Malai, Number of Seeds per Malai, Seeds Weight per Malai, Weight of 100 Seeds

Based on the observation, genotype diversity can be recognized more clearly in the generative phase. Quantitatively, there are differences in morphology of nine panicles studied (Figure 1). Table 2 shows that Tulungagung 2 genotype has a longer panicle compared to other genotypes, which is 50.92 cm but not followed by the number of seeds per panicle. The lowest average length of the panicle is in the Jombang genotype (20.51 cm) and is not different from the Tuban genotype.

The highest number of seeds per panicle is owned by Sampang 2 genotype, which is 3,002.00 and not different with Lamongan 1 genotype while the lowest is Sampang 1 genotype, as much as 471,78.

The Tuban genotype had a higher seed weight per panicle than the other genotype, which was 96.74 g while the Sampang 1 genotype had lower seed weight than the other genotypes.

The highest 100 seed weight was also achieved by Tuban genotype, of 3.20 g, although not unlike the Tulungagung 2 genotype. Sampang 1 genotype was lower in weight than the other genotype, which is 1.89 g.

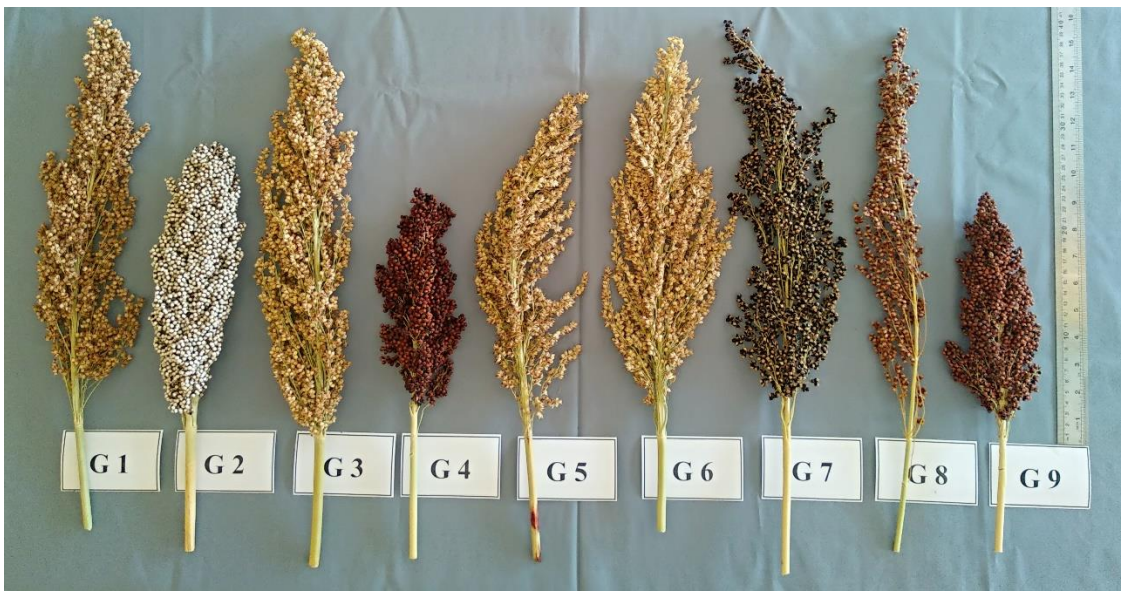

Figure 1. Morphology of Nine Panicles Sorghum Local at East Java

Table 2. The size of panicles, number of seeds panicle-1, seed weight panicle-1 and 100 seeds weight

Genotype	Panicles Length (cm)	Number of Seeds Panicle^{-1}	Seed Weight Panicle^{-1} (g)	100 Seed Weight
Pasuruan	30.48 c	2005.11 b	51.61 b	2.81 e
Lamongan 1	26.89 b	2871.66 cd	61.21 cd	2.36 c
Lamongan 2	39.47 de	2606.78 c	58.38 cd	2.24 b
Tuban	22.00 a	2197.44 b	96.74 f	3.20 f
Sampang 1	41.09 e	471.78 a	23.57 a	1.89 a
Sampang 2	37.03 d	3002.00 d	56.48 bc	2.28 bc
Tulungagung 1	41.61 e	2726.22 c	65.57 e	2.61 d
Tulungagung 2	50.92 f	2257.78 b	64.34 de	3.13 f
Jombang	20.51 a	2096.56 b	55.39 bc	2.61 d
Tukey Test 5%	3.40	277.19	6.48	0.12

Note : The numbers followed by the same letter in the same column show no significant difference in the 5% Tukey Test

4. Conclusion

Based on the results of the characterization, there are eight genotypes that have the potential to be developed as a parent in the development of superior cultivars, because they have good agronomic character, namely Pasuruan, Lamongan 1, Lamongan 2, Tuban, Sampang 2, Tulungagung 1, Tulungagung 2 and Jombang genotype.

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